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ANAEA OF THE ANTILLES AND THEIR CONTINENTAL RELATIONSHIPS WITH DESCRIPTIONS OF NEW SPECIES, SUBSPECIES AND FORMS  
(LEPIDOPTERA, RHOPALOCERA,  
NYMPHALIDÆ)

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Distributed from the region of the Mississippi basin in North America, throughout the Antilles, Mexico, Central America and South America to 25 degrees south of the equator, the Neotropical genus *Anaea* is represented by about 225 described names although, excluding synonyms, the number of distinct species is considerably less. Godman and Salvin in the "Biologia" (1884) state that there are "not less than 100 species, . . . no less than thirty-five occurring within our limits." [Mexico and Central America.] Dr. Carlos C. Hoffmann in a recent paper (1940, Cat. Sisten. y Zoogeo. Lep. Mex.) lists 21 species from Mexico. In North America three species have been recorded and in the Antilles five species with a considerable number of subspecies and forms; and it is with these, their distribution and relationship to those of Central and South America that this study is mainly concerned.

ANAEA Hübner

Genotype.—*troglodita* (Fabricius).

1819, *Anaea* Hübner, Verzeichniss bekannter Schmettlinger, p. 49. (Generic synonymy is omitted as unnecessary here.)

This genus is characterized by the cross-veins which, in the

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forewings, connect the subcosta with the margin and the radius with the subcosta. The number and position of these cross-veins varies among the species. The cell of the forewing is closed and the cell of the hindwing feebly closed. The genus is placed by many authors as the highest of the butterflies.

Consideration of the Antillean species shows that they are divided into three groups and that each of these groups contains continental species as well, with which the Antillean species are more or less closely associated.

#### Group I

These species of *Anaea* are of medium to large size, some having a length of forewing exceeding 40 mm. Male and female are similar and both have the inner margin of the forewing straight and have tails at  $M_3$  of the hindwing. The color of the upper-side is generally red. The male genital armature has porrect, antler-like gnathos.

This group inhabits the southern and central area of North America, Mexico and a little to the southward, the Greater Antilles and St. Kitts.

*Anaea andria* Scudder (Figs. 1-5).

1871, *Paphia glycerium* Edwards, Butt. N. Am., I, Pl. Paphia, Figs. 1-6.

1874-1875, *Anaea andria* Scudder, Bull. Buffalo Soc. Nat. Hist., II, p. 248.

1877, *Paphia ops* Druce, P. Z. S., London, p. 633.

1889, *Anaea andria* Scudder, Butt. Eastern U. S. and Canada, III, p. 1796.

1916, *Anaea andria*, Röber, Macrolep. World, V, p. 581, Pl. 117e.

1931, *Anaea andria* Holland, Butt. Book, p. 173, Pl. xxiv, Fig. 1, ♀.

1940, *Anaea andria* Field, Bull. Univ. Kansas, XXXIX, No. 10, p. 107.

Of most extended distribution in North America, this species ranges throughout the Mississippi basin from West Virginia and North Carolina to Illinois, Colorado and Texas. There is also a record from Jalapa, Mexico. It was described without a specific

type by reference to Edwards' figures of "*glycerium*." The source of the imagoes figured by Edwards is not stated but they may have come from Illinois or Missouri. Scudder (1889) quotes a correspondent (Rowley) who "asserts that there are at least two broods of the imago, and that there is a decided seasonal dimorphism in the two broods of the female." More recently, Mr. Harold I. O'Byrne, who has done much collecting in Missouri where *andria* is common, says that he has noted the difference in the summer and fall broods of *andria*. However, it is difficult to separate the broods on any basis of dates because of the long life of the imago. The fall brood lives over the winter and into the succeeding summer, overlapping in part the summer brood, which also overlaps the succeeding fall brood. Thus it is possible to find both summer and fall broods on the wing together during the early summer and again in the fall. Yet there exist two separate broods quite distinguishable one from the other.

*Anaea andria* Scudder is the fall brood which overwinters, flying again in the spring. *Anaea ops* (Druce) is a synonym of this as is shown by photographs made by Mr. C. F. dos Passos of the type (British Museum, No. 10370, *Paphia ops*, ♂, Texas). A colored drawing of this type is also before us.

*Anaea andria*, summer form **andriaesta**, new form.

This differs from *andria* in the following characters:

Size and shape:—fall form *andria* has a length of forewing of from 29 to 32 mm. (male), and from 32 to 38 mm. (female); and the summer form from 28 to 34 mm. (male), and from 32 to 39 mm. (female). In the summer form, the outer margin of the forewing tends to be straight; thus the apex of the forewing is not acute, though the costal curvature is approximately the same as in the fall form *andria*. With slight variation in individuals, this characteristic holds true for both males and females. Expressed another way, the outer margin of the forewing is less excavated toward the apex in the summer form than in the fall form. In the summer form the outer margin of the hindwings is less rounded and the apical angle is more obtuse than in the fall form.

Ground-color:—in the summer form the orange-red ground-color is more brilliant in the males and paler in the females than in the fall form *andria*.

Markings:—in the forewings of the summer form males the black sealing which forms the marginal wing-band is narrow and sometimes obsolete. In the fall form this black sealing is heavy and forms a definite border-band broadened at the apex. In the summer form males the cell spot of the forewing is obsolete, whereas in the fall form males this spot is well defined. In

the hindwings of the summer form males the black marginal scaling is cut along the veins by streaks of the bright ground-color, producing in some individuals a series of black marginal spots joined at the marginal edge. In the fall form this black border-band is pronounced, only very slightly penetrated along the veins by the bright ground-color.

The summer form females have less definite characters in their markings to separate them from the fall form females. They seem consistently paler in ground-color; the vein outlining is more distinct and there is less black scaling. As with the fall form there is some variation in individuals. The tint of ground-color in the interspace between the mesial line and the border varies from being the same as in the basal area to distinct lighter.

Underside markings of both males and females of the summer form seem less definite than in the fall form. Individuals of the fall form *andria* show distinct patterns; many summer form individuals show hardly any pattern.

Types:—holotype, male, Alexandria, Louisiana, September 5, 1935; allotype, female, Jefferson Barracks, Missouri, 1932, both from the collection of Mr. C. F. dos Passos. Paratypes:—four males, Birmingham, Alabama, August 8–9, 1916 (F. E. Watson); one male and one female, Mobile, Alabama, September 3, 1925; one male, Texas, No. 1465, collection J. Angus; one male and one female, Texas, No. 5342 collection Hy. Edwards; one female, Jefferson Barracks, Missouri; one female, Springfield, Colorado, June 10, 1919. All are in the collection of The American Museum of Natural History.

The following paratypes are in the collection of Mr. C. F. dos Passos: one male, Sarita, Texas, June 16, 1932; one male, Hunter, Oklahoma, August; one male, Hamilton, Kansas, October 17, 1925; one female, George West, Texas, June 11, 1940; one female, Concordia, Missouri, August 11, 1929. The following paratypes are in the collection of Mr. Frank Johnson: two males, Birmingham, Alabama, August 8–9, 1916 and August 26, 1927; one female, no data. One paratype, male, Kentucky, is in the collection of Mr. Otto Buchholz. One paratype, male, San Antonio, Texas, July, 1899 (O. C. Poling), collection R. C. Williams, Jr., is in the Academy of Natural Sciences of Philadelphia.

With *andria* we have a species living in a uniform environment in the great basin area of the Mississippi River and its tributaries, bounded on the east by the Appalachians and on the west by the Rocky Mountains. This species shows great uniformity throughout its range, as would be expected with a strong flying butterfly living in an extended and unconfined range.

Its usual variation is as previously defined but it occasionally produces an aberrant form as shown by a female *andria* (Wildard, Missouri, October 9, collection of Mr. C. F. dos Passos) in which the upperside is extremely suffused with black scales. In the forewings this black scaling covers the apical half of the wings, obscuring all normal banding. In the hindwings this black scaling extends beyond the mesial line but does not obscure it. The underside is normal. Reference is made to several similar aberrations by Field.

**Anaea aidea aidea** (Guérin-Ménéville) (Figs. 6, 7).

1844, *Nymphalis aidea* Guérin, Icon. Règne Anim. Ins., p. 478.

1916, *Anaea aidea*, Röber, Macrolep. World, V, p. 582, Pl. 118a.

The type of this species is a male taken on shipboard "more than a league at sea" on Campeche Bay, Mexico. Its recorded distribution extends throughout Mexico and south into Guatemala and Honduras from many localities. It is a distinct species, not a race of *troglydyta* as placed by Röber.

**Anaea aidea f. morrisonii** (Edwards).

1883, *Paphia morrisonii* Edwards, Papilio, III, p. 8.

1883, *Paphia morrisonii* Edwards, Can. Ent., XV, p. 35.

1898, *Anaea morrisonii* Holland, Butt. Book (1st Ed.), p. 193, Pl. xxiv, Fig. 2 ♀.

1916, *Anaea morrisoni* Röber, Macrolep. World, V, p. 582.

1916, *Anaea appiciata* Röber, Macrolep. World, V, p. 582.

1926, *Anaea aidea* Barnes and Benjamin, Bull. So. Calif. Acad. Sci., XXV, p. 16.

1931, *Anaea morrisoni* Holland, Butt. Book, p. 173, Pl. XXIV, Fig. 2 ♀.

1940, *Anaea aidea f. morrisoni* Field, Bull. Univ. Kansas, XXXIX, No. 10, p. 108.

The relationship of *morrisonii* to *aidea* is pointed out by Field. *A. aidea f. aidea* is the summer or dry season form and *A. aidea f. morrisonii* is the winter or wet season form. Field records *morrisonii* from Scott County, western Kansas and gives other United States records of its distribution from Texas, Arizona and

California. Mexican records of *morrisonii* are numerous where it flies in the same places as *aidea* far to the south. Holland (1931) calls attention to a mistake made by Barnes and Benjamin in placing *morrisonii* as a synonym of *aidea*.

There is a curious complication concerning the authorship of the name *morrisonii*. The original reference to *morrisonii* by Edwards in "Papilio" is more a citation than a description.\* The actual description by Edwards in the "Canadian Entomologist" seems to have escaped attention until cited by Field. Edwards omitted the reference to his description in his catalogue of 1884 and it had been overlooked since, the "Papilio" reference being the only one cited until Field's publication. Holland was apparently unaware of the description for, although he originally credited the species to Edwards, he later appropriated the name "*Anaea morrisoni* Holland (Edw. Ms.)" making a synonym.

In the interim, Röber described: "appiciata Stgr. i. l. from Mexico being also somewhat more brightly colored." Röber considered his *appiciata* as a race of *troglydyta* and contrasted it with *aidea* which he also placed as a race of *troglydyta*. This association is incorrect as will later be shown and *appiciata* is a synonym of *morrisonii*.

W. H. Edwards in his description did not fix the type of *morrisonii*: "From one male, from Western Texas, in the collection of Mr. B. Neumoegen, and 3 females, taken by Mr. Morrison, on Mt. Graham, Arizona." Mr. Wm. D. Field has kindly examined for us the collection at the U. S. National Museum (where the Neumoegen collection is deposited) and has been unable to find the male from western Texas. However, there is in the collection one of Edwards' "females" which is actually a male. This bears, among others, the label "Morrisoni ♀ Mt. Graham, Ariz." in Edwards' handwriting.

Through the kindness of Dr. A. Avinoff we have examined the two types in the Carnegie Museum at Pittsburgh. These are two males bearing similar labels in Edwards' writing: "Morrisoni ♀ Mt. Graham Ariz." in black ink with the word "type" written across the left end of the label in red ink.

\* According to the International Rules of Zoölogical Nomenclature, The Law of Priority, Article 25, a; the "Papilio" reference might be interpreted to be the original description for it was an "indication" of a new name.

Thus the three "females" exist but all are males of what is generally recognized as *morrisonii*. We make one specimen the lectotype ♂ and have so labeled it. This is reasonably perfect but slit midway of the left hindwing, and slit in from the anal angle of the hindwing. The right antenna is missing. It carries the Edwards' label as mentioned above with the additional label "Holland Collection." It is in the collection of the Carnegie Museum, Pittsburgh, Pa.

***Anaea aidea cubana* (Druce) (Figs. 8, 9).**

1905, *Perrhanaea cubana* Druce, Ann. Mag. Nat. Hist. (7th Series), XVI, p. 549.

1916, *Anaea cubana*, Röber, Macrolep. World, V, p. 581, Pl. 117d.

This large, richly colored butterfly appears to be confined to Cuba. It looks like an enlarged and enriched development of *aidea* f. *morrisonii*, the association appearing particularly close in the females. In most of the specimens examined the forewings are apically falcate, like *morrisonii*, but occasional specimens occur where the projection is reduced. The male genital armature shows that *cubana* and *aidea* with form *morrisonii* are sub-specific.

***Anaea aidea floridalis*, new subspecies (Figs. 10, 11).**

1916, *Anaea portia*, Röber, Macrolep. World, V, p. 581, Pl. 117d.

(This figure shows a female, quite evidently of the Floridian subspecies.)

1931, *Anaea portia*, Holland, Butt. Book, p. 173, Pl. XXIV, Fig. 3 ♂.

Size and shape:—males have a length of forewing of from 35.2 to 37.7 mm., females from 37.8 to 41.7 mm. The average is slightly smaller than *cubana* in either sex, but much larger than *aidea*. The forewing shape of the males is slightly less falcate than in *cubana* or *morrisonii* and the outer margin is slightly undulate as in *cubana*. The hindwing shape is like that of *cubana* but the tails are slightly stockier. The outer margins of the *aidea* subspecies are generally more regular than is the case with the various subspecies of *trogodyta* to be discussed later. The females have similar wing-shape characters.

Groundcolor:—in males this is a bright orange-red, in contrast with the orange-brown ground of *aidea* or the considerable buff tinting of *cubana*. The color of the females is less brilliant than that of the males, brighter than in *aidea* and *morrisonii* and very similar to the color of the forewings of *cubana*. Compared with the various subspecies of *trogodyta* there is little difference in color but there is less violet reflection in Floridian males.

Markings:—males on the upperside have a relatively narrower and straighter fuscous border than do any other closely related species or subspecies. The widening of the border between  $M_3$  and  $Cu_1$  is mostly an obsolete character. In the apical area the fuscous scaling is much reduced. The forewing mesial band is variable; October specimens show a definite, black band but later specimens as in December and February show the band to be faint to obsolete. In the hindwings there is little difference from other species. Females have heavier marginal bands, well emphasized mesial lines and cell spots. In the anal areas of the hindwings the fuscous scaling replaces the buff color occurring in *cubana*. The interspace between the forewing mesial line and the border is broader than in *aidea* or *cubana*, but is like them in being less jagged than in any of the *trogodyta* subspecies.

On the underside, males and females are predominantly grey, variously shaded, with a ruddy flush extending over the forewings, though frequently obscured with grey in the anterior half of the wings. This is different from the buff tinting of *cubana* or the greenish-buff tinting of *aidea*. In general, the effect of the underside is much like *trogodyta*, though more brilliant than in any of these subspecies. A notable point of difference occurs in the two spots in the anal area of the hindwings. In over 100 Floridian specimens examined, the spot above the tail is always the larger, that towards the anal angle the smaller, sometimes obsolete, in one case absent. While this is a character found in *cubana* it is not the case with any *aidea* examined in which these spots are of equal size (whether larger or smaller in individuals) and in which there are frequently two other lesser spots close to the anal angle. In over 100 specimens examined of the several *trogodyta* subspecies, the anal spots show consistent equality of size varying in individuals from an equal pair of minute spots to an equal pair of pronounced spots (as in Jamaican *portia*).

Male genital armature:—the harpés are closely rolled and blunt-ended, a characteristic of *aidea*; the gnathos are spread-ended and toothed, also a general character, but differ from those of *aidea* in having pronounced thumb-like toothed branches. In general the gnathos are similar to those of *cubana* but differ in details of structure (Figs. 6–11).

Types (all from Florida):—holotype, male, Florida City, December 10, 1936; allotype, female, Miami, February 18, 1923; Paratypes:—one male, Florida City, December 10, 1936; one male, Royal Palm Park, December 4–10, 1937; three males and four females, Biscayne Bay, collection of Mrs. A. T. Slosson; one female, Homestead, April 18, 1923. All are in the collection of The American Museum of Natural History. Two paratypes are in the collection of Mr. C. F. dos Passos: male and female, Miami, February 2, 1932. Four paratypes are in the collection of Mr. Otto Buchholz: from Florida City, two males, October 10, 1933,



and October 9, 1937; two females, October 28, 1936, and October 9, 1937.

*Anaca aidea floridalis*, summer form **floraesta**, new form.

The reported dates of *floridalis* show it flying from October into April but a different form occurs from May into October. As fresh specimens appear throughout the year there must be a number of broods but the butterflies of the winter or wet season are different from those of the summer or dry season.

In males and females the average size of the summer form does not differ from the winter form. In wing-shape the summer form shows the same divergence noted in other species under similar conditions; the forewings are not as deeply excavated in the outer margin, thus effecting a blunt apex; and the tails are slightly more robust, thus appearing shorter.

In males, the mesial line of the forewing is more obvious, the forewing borders less so and the fuscous scaling of the hindwing borders is reduced so that the ground-color shows through as a series of spots. In females, the same characters hold but to a less contrasting degree. On the underside, there are no particular points of separation. The male genital armature is the same as in *floridalis*.

Types (all from Florida):—holotype, male, Brickell Hammock, Miami, August 2, 1939, from the collection of Mr. C. F. dos Passos; allotype, female, Florida City, August 14, 1937. Paratypes: males,—one, Brickell Hammock, Miami, July 29, 1939, from the collection of Mr. C. F. dos Passos; two, Miami, July, 1904; one, Florida City, May 19, 1938; females—two, Florida City, July 31, 1933, and October 10, 1937; one, Miami, July, 1904. All are in the collection of The American Museum of Natural History. Paratypes in the collection of Mr. C. F. dos Passos are:—males—four, Brickell Hammock, Miami, August 2, 1939; one, Florida City, August 11, 1933; two, Coconut Grove, August 2, 1939; females—two, Brickell Hammock, Miami, August 2, 1939; one, north-west section Miami, August 3, 1939; one, Florida City, September 2, 1932. Paratypes in the collection of Mr. Otto Buchholz are male and female from Florida City, respectively July 4, 1936, and June 2, 1937.

Occurring in southern Florida, *floridalis* is associated with *aidea* but is more closely connected with *cubana*. The male genital structures show that the three are of one species which divides, in three separate populations, into three subspecies having main characters in common but each differing from the other in minor characters.

It does not seem unreasonable to suppose that the Floridian subspecies originated at some geologically recent date as a migrant from Cuba. Its affinities are distinctly with *cubana* in superficial characters of size, shape and wing pattern and in the structure of the gnathos and harpés (Figs. 8–11). Cuban and Floridian specimens have more in common than either has with the continental subspecies *aidea*. To account for the Floridian subspecies by continental distribution is difficult because *aidea* apparently reaches an extreme northern and eastern limit in Kansas. The Mississippi basin, populated by *andria*, intervenes and also most of the length of Florida before the home of *floridalis* is reached, the southern part of the peninsula of Florida.

Mr. Dean F. Berry says that in fourteen years collecting in the eastern area of Florida, in Orange County and southward through Okeechobee and St. Lucie Counties, he has never seen "*portia*." All known records are from Miami southward.

The naming of the Floridian subspecies raises a question of taxonomy, as may easily be discovered by a perusal of the literature. The name applied to the present is *portia* (Fabricius) based on a determination by Schaus (1898, Ent. News, IX, p. 96). This and also *troglogyta* is inapplicable as will later develop.

So far two species with subspecies have been discussed. The first is *andria* with its form *andriaesta*; the second is *aidea aidea* with its form *morrisonii*, *aidea cubana*, and *aidea floridalis* with its form *floraesta*. There is a third species, *troglogyta*, with several related island subspecies, which is certainly closely connected with both the other species, but with equal certainty is specifically distinct and endemic. These three species with their subspecies occupy distinct regions; two species overlap slightly, but the others are separated.

In the appearance of the imagoes the five subspecies comprising *troglogyta* are very close to each other and superficially similar to *floridalis*. The *troglogyta* subspecies may be separated in facies from *floridalis* by the characters previously given but their separation from each other depends on slight differentiating characters. Fortunately the male genital characters of each are excellent and consistent and make possible a definite separation

of the *troglodyta* subspecies. Further each subspecies is found in a separate island and sufficient material has been studied to place these subspecies safely by their geographical location.

As here recognized, there are five separate populations which occupy Jamaica, Hispaniola, Puerto Rico, Virgin Islands and St. Christopher (St. Kitts). Before considering these butterflies biologically it seems best to study their taxonomy and place the existing names where they belong as nearly as may be from the evidence available.

***Anaea troglodyta troglodyta* (Fabricius) (Figs. 12, 13).**

1775, *Papilio troglodyta* Fabricius, Syst. Ent., p. 502, No. 250.

1781, *Papilio troglodita* Fabricius, Species Insect., II, p. 87, No. 348.

1787, *Papilio troglodita* Fabricius, Mant. Ins., II, p. 47, No. 464.

1793, *Papilio troglodyta* Fabricius, Ent. Syst., III, Part 1, p. 77, No. 240.

1819, *Anaea troglodita* Hübner, Verz. bek. Schmett., p. 48, No. 445.

1877, *Paphia troglodyta* Druce, P. Z. S., London, p. 633.

1916, *Anaea troglodyta* Röber, Macrolep. World, V, p. 581. Pl. 117d(3) ♂.

Fabricius gives "Habitat in America, Mus. D. Hunter." However the most likely source of Fabrician material is the Greater Antilles. It seems very unlikely that specimens came from southern Florida for all of the early explorations and settlements were in northern Florida, whether Spanish, French or English. As for the Lesser Antilles, this species of *Anaea* has never been reported further south than St. Kitts. Jamaica, Hispaniola, Puerto Rico and Virgin Islands are the obvious places from which this early material may have come.

With sufficient material from all of the islands available, the brief original descriptions prove helpful. The description of *troglodyta* applies to a male and in describing the hindwings there is the following:—"Puncta aliquot ferruginea, obsoleta in margine fusco. . . ." Of all the island populations, males from Hispaniola are the only ones which exhibit these rusty ground-

color spots in the dark margin in the described degree. The further fact that the insect is common on Hispaniola and occurs at all seasons would increase the likelihood of its capture. Herbert Druce says of *troglodyta*:—"It is peculiar to the West Indies" and gives the habitat "Haiti (Tweedie), Jamaica (Cutter)." For *portia* which "may be only a variety" he gives the habitat "Jamaica." It is on this evidence that the name *troglodyta*, which is the nomenclatory stem of the species, is assigned to the subspecies in Hispaniola.

**Anaea troglodyta portia** (Fabricius) (Figs. 18, 19).

- 1775, *Papilio portia* Fabricius, Syst. Ent., p. 507, No. 268.  
 1793, *Papilio portia* Fabricius, Ent. Syst., III, Part 1, p. 78, No. 242.  
 1807, *Hamadryas undata astina* Hübner, Samml. exot. Schmett., I, Pl. 56, Female 1, 2.  
 1877, *Paphia portia* Druce, P. Z. S., London, p. 633.

Fabricius gives "Habitat in America V. Rohr." in 1775 and "Habitat in Americae Insulis Dom. V. Rohr." in 1793.

Accumulated evidence associates the name *portia* with the Jamaican subspecies. The description is of a female and as a distinctive character Fabricius says of the underside of the hindwing:—"Puncta duo distincta nigra in alis posticis ad marginem posticum." An examination of a series of Jamaican *portia* shows that these two spots are of equal size and stand out distinctly on a violet-grey ground in the average much more so than is the case with any other insular subspecies. At the end of his description Fabricius refers to the male:—"Varietas paulo minor alis anticis minus falcatis fulvis, puncto unico nigro, An mas?" (A little smaller variety with the less falcate fulvous forewings, with single black spot, a male?) Of all the island subspecies the mesial line of the forewing is least emphasized in the Jamaican males. The English lepidopterists, Doubleday, Butler and Druce, give the locality of *portia* as Jamaica. It would seem reasonable to accept this allocation.

*Hamadryas undata astina* Hübner is here determined as a female *portia*, despite the fact that it was placed as a synonym of *troglodyta* Fabricius by Hübner (1831, *Zutrage zur Sammlung exotischer Schmetterlinge*, III, p. 36).

**Anaea troglodyta astina** (Fabricius) (Figs. 16, 17).

1793, *Papilio astina* Fabricius, Ent. Syst., III, Part 1, p. 81, No. 251.

1781, *Papilio astinax* Cramer. *Papilio astianax* Cramer. Pap. Exot., IV, pp. 91, 248, 4, Pl. 337 A B.

1823, *Papilio agathon* Dalman, Analecta Entomologica, p. 42.

Because of existing names the next insular butterfly to consider is that of the Virgin Islands. Cramer described *Papilio astianax* from St. Thomas. The spelling *astinax* in the Dutch text, first column, is considered a *lapsus calami* as the spelling is given *astianax* in the French text, second column, and in the index (p. 248), and again in Stoll's systematic arrangement (p. 4). *Papilio astianax* is a homonym of *Papilio astyanax* Fabricius (1775) as i and y are ruled interchangeable. Dalman noted this homonym and proposed the name *agathon*. Fabricius also described this St. Thomas butterfly as *astina* saying "anticis lunula atra" referring to the peculiarity of the costal black triangular mark near the apex shown in Cramer's figure and a character of the facies which separates the Virgin Island subspecies from others. Thus *astina* (Fabricius) has precedence and of it *astinax*, *astianax*, and *agathon* are synonyms. Specimens from St. Croix and St. Thomas are alike.

The female of *astina* seems to be undescribed. It is as large as *troglodyta* females and almost indistinguishable from them. It is larger than the females of the remaining island subspecies and has a more jagged mesial line of the forewing and a pronounced junction of this line with the border along  $M_3$ . The specimen described is from St. Thomas, Virgin Islands, November 22, 1925, the type locality of the subspecies. It is designated as a plesiotype and is in the collection of The American Museum of Natural History.

**Anaea troglodyta minor** Hall.

1936, *Anaea troglodyta minor* Hall, Entom., London, LXIX, p. 274.

The remaining described subspecies is *minor* Hall from St. Kitts. This is a small form as described and though no speci-

mens are available for study, it seems a safe assumption that it is a valid subspecies. From the characters given in the description its appearance must be very similar to that of the following subspecies which inhabits Puerto Rico.

*Anaea troglodyta borinquenalis*, new subspecies (Figs. 14, 15).

Size and shape:—the length of forewing in males ranges from 31.5 to 34.2 mm., and the length from base to tip of tail of hindwings from 30.8 to 34 mm. In females similar measurements give from 31.3 to 37.4 mm., and 29.7 to 35 mm., respectively. These are thus slightly smaller than the average of *portia* and appreciably smaller than the average of *trogldodyta* or *astina*. The forewings of both sexes are falcate as in *portia* and equally slightly variable in different specimens. The hindwings are more regular in outline with less tendency to scallops between the vein projections thus differing from *portia*. The tails are slightly shorter and broader than in *portia* but not so much so as in *trogldodyta*.

Ground-color:—the tawny-red upperside of the wings of the males is the same as with other subspecies of *trogldodyta* with the rose reflections. The females are slightly paler than *portia* and lack the contrasting tints evident in *trogldodyta* and *astina*.

Markings:—the differences in markings between the several subspecies becomes evident only in comparisons of series of specimens, where the summation of all characters gives weight to the distinctions. In males from Puerto Rico the pattern made by the black markings is different from other subspecies but in elusive and slight characters difficult of definition. The mesial band of the forewing (obsolete in *portia*) is slightly more evident than in *trogldodyta* and a little less so than in *astina*. In the black border, in the interspace between  $M_3$  and  $Cu_1$  there is an indentation doubling the width of this black space and projecting along  $M_3$  as a line to join the mesial band. The hindwings exhibit a slightly narrower black border than in other subspecies, unless it may be equally narrow in *minor* (which differs according to the description in other particulars).

The markings of the females repeat with more emphasis those of the males and differ proportionally in the same respects from other subspecies. On the underside, the elusive and indeterminate characters of the individually variable markings make description difficult. The two equal black spots in the anal area characteristic of *portia* are fully as definite in some specimens as in some specimens of *portia* but in the average they are less so.

Male genital armature:—the character of separation is definite for the Puerto Rican population. That these butterflies belong to *trogldodyta* is obvious because they have the characteristic general type of armature and particularly the strongly developed hook-shaped terminals on the harpés. They also possess slender much incurved gnathos, sharply pointed with small side teeth. This is the simplest kind of gnathos to be found among the four *trogldodyta* subspecies examined and is as definitely and clearly distinct from the others as they are *inter se*. (Figs. 12-19.)

Types (all from Puerto Rico) :—holotype, male, Tallaboa near Ponce, July 23, 1914; allotype, female, Ensenada, June 14–19, 1915. Paratypes :—two males, Tallaboa, March 7, 1927, and July 23, 1914; female, Ponce, July 20–22, 1914. All are in the collection of The American Museum of Natural History.

In the male genitalia of these *Anaea* of "Group I," the tegumen is broad with a well developed uncus, the vinculum is slender, and the saccus mostly well developed. Attached to the tegumen at either side above the vinculum are twin processes called gnathos and below these the harpés are broadly attached to the vinculum. The characters most useful for separation appear in the porrect gnathos and secondarily in the harpés. The ædeagus seems a little variable among the species. For study, wet preparations are necessary to get proper views of the structures.

All of the *Anaea* so far considered are easily separated by their genital structures.

First :—*andria* shows bridged and branched gnathos bluntly tipped with a series of small teeth; broad harpés with a pronounced sacculus and a short broadly-based terminal tooth. Spines (not shown in figures) are numerous on these organs but this is a character common to all species. (Figs. 1–5.)

Second :—*aidea*, *cubana* and *floridalis* have a uniform type of genital armature generally similar to *andria* but differing therefrom in a shorter saccus and other important features. They are further subspecifically separable each from the other by the varying gnathos, bridged by a membrane, broadly branched and with many terminal teeth of variable size. The harpés are more closely rolled than in *andria* and blunt at the end with an obsolete terminal tooth. (Figs. 6–11.)

Third :—*portia*, *troglydyta*, *borinquenalis* and *astina* are each distinct but have genital characters in common which separate them from the first and second species mentioned. Here the gnathos, bridged by a membrane, are slender and distinctly falcate and the harpés have a relatively large, falcate, terminal projection. *Anaea minor* Hall from St. Kitts would seem a probable member of this assembly but, lacking material, this cannot be confirmed. (Figs. 12–19.)

As to the possible intermingling of *aidea cubana* and *troglo-*

*dyta troglodyta* there is no evidence despite the proximity of Cuba and Hispaniola. There are records of *cubana* from various localities in central to eastern Cuba. There are no records of *troglydyta* from Cuba. On Hispaniola, *troglydyta* is well distributed with coastal records from northern and western Haiti. There are no records of *cubana* from Hispaniola. The two species as far as reported are each confined to their own insular homes.

In a series of 60 specimens of *troglydyta* from various localities in Hispaniola over half were caught in February and March. Classed with these are early April specimens. These are all of the decidedly falcate wing-type in both sexes. Then, with one specimen dated June 29, there is a series caught in July and August. The indication is that there are two broods and there may be more. Among the dry season specimens there are some which have the straight outer forewing margin and others which have the falcate wing but in a degree less pronounced than the extremes of the brood occurring earlier in the year. No constant differences seem to occur in upperside marking to separate the broods but on the underside the pattern is less defined in the dry season brood. The Hispaniola records, from 17 localities, are all coastal points or not far inland; none are from the highlands of the interior.

## Group II

These species of *Anaea* are of medium size with a length of forewing of 25 to 35 mm. The sexes are dissimilar but both have a straight inner margin to the forewing. The males may have rounded hindwings or may develop a projection from a short spike to a definite tail at  $M_3$ . This variation may occur in males of a single species. The females are always tailed at  $M_3$ . The color of the upperside of males is tawny-red, tawny-brown or purple; of females buff to brown. The underside patterns are highly variable between individuals of the same species. The gnathos of the male genital armature extend ventrad with a continuous broad bridge between the sides.

This group as a whole has a very extensive continental range. There is but one Antillean species, *johnsoni* from Jamaica.



## Section 1.

**Anaea ryphea** (Cramer) (Figs. 23, 24).

- 1775, *Papilio ryphea* Cramer, Pap. Exot., I, p. 76, Pl. 48 G, H.
- 1834, *Anaea phidile* Hübner, Zut. Samml. exot. Schmett., V, p. 27, Figs. 905, 906.
- 1865, *Paphia erythema* Bates, Jour. Entom., II, p. 342.
- 1877, *Paphia ryphea* etc., Druce, P. Z. S., London, p. 634.
- 1916, *Anaea ryphea* etc., Röber, Macrolep. World, V, p. 582, Pl. 118.
- 1929, *Anaea phidile* ab. *albomaculata* Neustetter, Int. Ent. Zeit., Guben, 28 yr., p. 392.

Cramer's *ryphea* was a male described from Surinam. It is of the kind which develops a short projection at  $M_3$  of the hindwings.

*Anaea phidile* Hübner, stated to be a female, is a male of *ryphea* of the kind which has an entirely rounded hindwing. The type locality was unknown to Hübner.

The butterfly Bates described as *Paphia erythema* came from "Upper Amazons, at St. Paulo." The types in the British Museum are labeled: male, No. 10720, São Paulo de Olivença; female, No. 10721, Amazons. With water-color drawings of these types before us it is evident that *erythema* is a synonym of *phidile*.

Neustetter's ab. *albomaculata* are specimens showing, on the underside of the hindwings, a mesial development of white spots.

The male genital armatures show that all of these names apply to but one species. Present evidence suggests that *ryphea* with the hindwing projection at  $M_3$  is the wet season male. The wet season female has contrasting tints of buff in the ground-coloring, appearing somewhat variegated and brilliant. The dry season form seems to be *phidile* (= *erythema*) with rounded hindwings in males and a uniform ground-coloring of deep buff in the females. As the seasons vary in different localities in the tropics nothing very definite can be said about the seasonal forms until much more exact data can be obtained.

The species *ryphea* extends over a tremendous range from

Mexico throughout South America to 25 degrees south. The males vary in size and richness of coloring on the upperside. The variations from the normal, russet, striated marking on the underside range from those only partly mottled with black to occasional specimens almost entirely black; and from those with a few small mesial white spots on the hindwings to some with a band of large white spots (ab. *albomaculata* Neustetter). Some striking specimens combine both the black and white markings. The females exhibit these black and white markings as well as the males. Some *ryphea* females are almost indistinguishable on the upperside from *euryppyle* females, but are separable by the underside pattern.

The structure of the gnathos in *ryphea* males separates this species from all others of the group (Figs. 23, 24). The presence of tubercules on the central surface is unique. The harpé is also straight across the end but in this respect *cratias* (Fig. 32) is similar.

The figures given by Röber are in some cases misidentified. On plate 118, line a, number 3 is *ryphea* f. *phidile* ♂, number 4 is *ryphea* f. *phidile* ♀; line b, number 3 is *euryppyle* ♂, number 4 is unidentified but not *ryphea* ♀, number 5 is *ryphea* f. *phidile* ♂, number 6 is *euryppyle* ♀ wet season; line c, number 1 is *ryphea* f. *phidile* ♂, number 2 is *euryppyle* ♂, number 3 is *sosippus* f. *rutilans* ♂, number 4 is probably *venezuelana* ♀, number 5 is southern, wet season *glycerium* ♂.

## Section 2.

### *Anaea euryppyle euryppyle* (C. and R. Felder).

1862, *Nymphalis euryppyle* C. & R. Felder, Wien. ent. Monat., VI, p. 119.

1877, *Paphia euryphile* Druce, P. Z. S., London, p. 635.

Typical *euryppyle* is tailed in both sexes and can be further separated from *ryphea* by the straight mesial line crossing the underside of the hindwing. The more regular (straighter) outer margin of the forewing in *euryppyle* separates it from *glycerium* which is definitely scalloped. It was described from equatorial Brazil but its range extends westward spreading from Bolivia to Colombia. It produces wet and dry season forms.

**Anaea eurypyle confusa** Hall (Figs. 20-22).

1929, *Anaea eurypyle confusa* Hall, Entom., London, LXII, p. 133.

From Mexico and Central America to Panama comes the subspecies *confusa* imagoes of which are generally smaller and darker. Like *eurypyle eurypyle* the wing markings on both sides generally follow a uniform pattern but occasional specimens have black mottling on the underside and others have white spots at the costa of the hindwing. This subspecies produces seasonal forms which are quite distinct. Some males may have the apex of the forewing produced (the wet season form); or have the outer margin of the forewing straight from the apex to a slight bulge before the cubitus extending to the tornus (the dry season form). The females may be either with falcate forewing, even fulvous ground-color, and brown darker markings (the wet season form); or with straight outer margin of the forewing, a trifle deeper fulvous ground-color varied with much paler apical fore- and hindwing spots, and black-brown darker markings (the dry season form).

The male genital armature is shown completely (Figs. 20-22) because *eurypyle* seems typical of the entire group. In the left lateral view (Fig. 20) the relation of parts shown is characteristic of all of the species of the group though slight modifications of shape occur between species. Nevertheless the structure of the gnathos in *eurypyle* has characters in common with three other species so that these four species form a section within the group. There is no apparent difference genitally between *eurypyle* and *confusa*.

**Anaea sosippus** (Hopffer) (Figs. 28, 29).

1874, *Paphia sosippus* Hopffer, Ent. Zeit. Stettin, 35 yr., p. 329.

1875, *Paphia rutilans* Butler, Ann. Mag. Nat. Hist., (4th Series), XV, p. 223.

1890, *Anaea sosippus* etc., Weymer, Stübel's Reisen, p. 120.

1916, *Anaea sosippus* etc., Röber, Macrolep. World, V, p. 583-4, Pl. 118c. (The figure is form *rutilans*.)

This species was described from two males from Chanchamayo, Peru, but its range extends from Ecuador to Bolivia. The rich

purple color of the male distinguishes it from other species of the group. The described form has rounded hindwings and occurs in the dry season. Butler's *rutilans* (type No. 10722, British Museum, from Pucartambo, Peru), considered a synonym by Weymer, has a tooth-like projection at the submedian vein of the hindwing. This is the wet season form. The elongation at  $M_3$  may even result in a moderate tail 2 or 3 mm. long.

The female of *sosippus* is undescribed. Designating a specimen from Ecuador as a plesiotype, in the collection of The American Museum of Natural History, it may be defined by comparison with dry season females of *ryphea* and *eurypyle*. The wing-shape, variable in individuals is similar in all three species. The tails are slender in *sosippus* and *ryphea*, heavier in *eurypyle*. On the upperside the pattern of marking is much more pronounced in *sosippus* than in either *ryphea* or *eurypyle*. In the forewings of *sosippus* a strong but irregular mesial line divides the basal area from the outer area, and this outer area is light buff as is also the light bar below the apex, contrasting strongly with the basal fulvous and the deep brown margin and apex. The irregular mesial line often appears lightly traced in *ryphea* but is obsolete to absent in *eurypyle*. In the hindwings, from above the tail to the anal angle, there are four or five black elongated points which occur similarly in the males of *sosippus*. All considered, female *sosippus* is a brighter, lighter colored butterfly than either *ryphea* or *eurypyle*. Like *eurypyle*, the species *sosippus* is distinguished from *ryphea* in having the mesial line on the underside of the hindwing straight, not irregular.

*A. sosippus* in the wingshape of the male has a similarity to *ryphea*. The structure shown in the gnathos, which has a cleanly outlined ventral margin, associates *sosippus* with *eurypyle*. It is therefore placed for classification between *ryphea* and *eurypyle*.

***Anaea ecuadoralis*, new species (Figs. 30, 31).**

Flying in central Ecuador is a peculiar species which shows an amount of individual variation surprising even for an *Anaea*. In the males it resembles *eurypyle* but it develops one form with a spike-like projection at  $M_3$  of the hindwings and another with definite tails. The females are tailed like all other females in this group of *Anaea* and the general wing-shape also corresponds. The pattern of marking of the female is also similar but the upperside color contrasts produce a very distinctive butterfly. A remarkable amount of vari-

ation occurs in the type series where there are not two alike in the underside marking of either males or females. In the males the prevalent underside ground-color is purplish-brown, rather richer than in *sosippus* and with much more contrast of marking. In some specimens the ground-color is overcast with grey; in others with black mottling; and in one there is a mesial row of white spots on the hindwing. The females are striated with brown, buff and grey on the underside; some with the pattern submerged, others with it pronounced. An astonishing peculiarity of both sexes is that the mesial line of the hindwing may be either straight as in *eurypyle* or interrupted excessively as in *ryphea*, thus bridging the gap between these two species in this characteristic. Despite the extreme variation of the specimens which, under some circumstances, might be interpreted as a number of different forms, there seems to be no good reason to regard this series of specimens as other than one species. Therefore, average specimens, male and female, are selected as the holotype and allotype.

Size and shape:—males have a length of forewing from 29 to 30 mm., females from 31 to 32 mm. The wing-shape of the males is the same as that of those *ryphea* males in which the hindwing vein  $M_3$  is produced to a spike. This spike may project no more than 1 mm., or may be prolonged as much as 4 mm., to form a slender tail. Females, though distinctly smaller, are shaped like dry season females of *eurypyle* with a straight outer margin of the forewing and no apical projection.

Ground-color:—on the upperside the males are uniformly more richly colored than *ryphea*, approaching the rich purple-red of *sosippus*; on the underside the effect is iridescent, grey-purple to rose-purple although the basic color is a dirty rust-brown. The females, on the upperside, have a dark rust-brown ground-color, much darker than any other species of this group; on the underside the ground-color is cream, like females of *sosippus* and lacking the yellow tone which produces the buff color of other species.

Markings:—on the upperside the males are marked like *ryphea* but with the ground-color spot in the black-brown apical area slightly more irregular, also the hindwings are dark-bordered with considerable variability in the extension of this border basad. A violet iridescent suffuses the upperside in oblique lights. On the underside the pattern is typical of the group but subject to unusual variability; the pattern of the forewings is fairly constant but the pattern of the hindwings is variable in that the mesial line may vary from being straight to wavy or even to jagged. Shade-bands of varying width and intensity as well as black mottling and white spotting in almost random distribution make a general description of the underside of the males nearly impossible as no two are alike. Females, while marked similarly to others of the group, are strikingly different from all others because of the dark dirty brown ground-color of the upperside and because the light spot in the dark apical area is white, thinly scattered with rusty ground-color scales. On the underside, on the cream ground-color, the typical markings of this group appear in varying intensity among specimens in various shades of brown. The mesial line on the hindwing varies as it does in the males and white spots may occur along it in some specimens.

Male genital armature:—the structure of the gnathos shows that *ecuadoralis* is closely associated with *euryppyle*. (Figs. 30, 31.)

Types:—holotype, male, and allotype, female, Ecuador, from the collection of Mr. Frank Johnson and deposited in The American Museum of Natural History with one paratype, male, Oriente, Ecuador. Paratypes in the collection of Mr. Frank Johnson are five males and five females, Ecuador, and two females, Oriente, Ecuador.

This most unusual species, in its wing-shape and markings, has features reminiscent of *ryphea*, *sosippus* and *euryppyle*. Because of its genital structure it is placed for classification in the section with *euryppyle* following *sosippus*.

**Anaea cratias** (Hewitson) (Figs. 32, 33).

1874, *Paphia cratias* Hewitson, Bolivian Butt., p. 9.

1916, *Anaea glycerium ornata* Röber, Macrolep. World, V, p. 583.

This species was described from Bolivia but occurs in a more extended range from Minas Geraes, Brazil, and southern Peru. Hewitson gives the color of the upperside "scarlet" which is not borne out by the type (No. 10715 ♂) examined in the British Museum. The color is a deep tawny fulvous similar to other species of this group. The white mesial spots of the underside of the hindwings mentioned in the original description can be exactly matched in occasional specimens. These white spots may be large, small or absent, as Hewitson remarks: "A specimen which corresponds in every other respect to that which I have just described is without the white spot on the underside."

The female of *cratias* is undescribed. Designating a female from Bolivia as a plesiotype in the collection of Mr. Frank Johnson, this may be compared with the male of the species for description. The wing-shape is similar except that the forewings are apically more acute, a variable character. The ground-color is paler, as usual in females, and therefore the dark maculation is more in contrast but placed as in the male. On the underside the specimen chosen is one in which black patching is well developed, presenting the opposite variation from the normal to that of the type male *cratias* which has white spots.

Röber's *ornata*, described from Coroico, Bolivia, as a subspecies of *glycerium*, is a synonym of *cratias*.

The male genitalia of *cratias* show that it is associated with *eurypyle* more closely than it is with *glycerium* although the appearance of the imago is such as to associate it with *glycerium*.

For classification *cratias* is therefore placed following *eurypyle* and belongs in the section arranged by the genitalia and made up of *sosippus*, *ecuadoralis*, *eurypyle* and *cratias*.

### Section 3.

**Anaea glycerium** (Westwood and Hewitson) (Figs. 25-27).

1759-64, *Papilio helie*, Clerck, Icones Ins., II, Pl. 34, Helie 103.

1850, *Paphia glycerium* Westwood and Hewitson, Gen. Diur. Lep., II, p. 317, Pl. 50, Fig. 1.

1882, *Papilio helie* Aurivillius, Recensio Crit. Lep. Mus. Lud. Ulricae, 179.

1916, *Anaea glycerium* etc., Röber, Macrolep. World, V, p. 583, Pl. 118c (No. 5 is *glycerium* ♂).

The type of *glycerium* came from Mexico (No. 10714, British Museum). The original figure and the type which has been examined show this to be a dry season male of that race of *glycerium* which flies from Mexico south to Panama. These average slightly smaller in size and are of a slightly deeper fulvous color on the upperside and darker on the underside than specimens from further south. Larger, paler specimens occur in Colombia and Venezuela and one specimen comes from French Guiana. The females are of paler buff color and they can be associated with their corresponding males in their respective regions. Though this southern race is recognized it is not now described as a new subspecies because of the insufficient data with the specimens in hand.

These butterflies produce seasonal forms both north and south, the wet season specimens being more incised and more apically pointed in the forewings than the dry season specimens. The subapical dark bar of the upperside of the forewings may be continuous or broken with different sizes of opening in a series from the same locality. More are broken in Colombian series and more

continuous in Central American series. On the underside of the hindwings a few specimens show small marginal white points and also a small costal white spot.

*Papilio helie* Clerck, is a homonym of *Papilio helie* Linnaeus which is presumably an Asiatic Satyrid according to Aurivillius. The butterfly Clerck figured is without doubt *glycerium* and a dry season male from the south in which the subapical dark bar is continuous.

The genital armature of the male of *glycerium* is uniform for specimens of various regions and seasons but it possesses structures in the gnathos (Figs. 25–27) which establishes section 3 of group II. Extending below the deep central sclerite of the gnathos is a folded curtain-like structure also occurring in modified form in the two following species which are associated with *glycerium*.

***Anaea venezuelana***, new species (Figs. 34, 35).

Size and shape:—males have a length of forewing from 25 to 26.5 mm., females from 28 to 29.5 mm. The wing-shape of the males is close to that of *glycerium* but the undulation of the forewing outer-margin is not so accentuated, although of the same kind. The scallop opposite the median area, pronounced in *glycerium*, is in this species very shallow. The hindwings are more prolonged, more angular and not so rounded as in *glycerium* and the margin is more regular, not noticeably scalloped as in *glycerium*. The same comparisons hold for the females of the two species.

Ground-color:—on the upperside in the males, the ground-color matches *euryppyle*, with the same blue iridescence, seen obliquely. On the underside the color is rust-brown overshoot with an illusive greenish-golden iridescence. The female (probably figured but with the color too bright, Macrolep. World, V, Pl. 118c–4, as “♂ *glycerium*”), matches fairly well the dry season females of *euryppyle* in ground-color. On the underside it is a lighter replica of its male.

Markings:—on the upperside, the black-brown apical area encloses a smaller and more irregular spot of ground-color than in *glycerium* males. Further, the lower enclosing band of brown is unbroken in specimens of the type series. In the forewings, the marginal dark area narrows toward the tornus and in the hindwings it continues narrowly to include the tail which is not the case in *glycerium*. Males on the underside have the *glycerium* pattern. Females on the upperside are marked more heavily than dry season *euryppyle* females and differ in having a tawny border band on the forewing which extends up to the apex through the dark brown apical area. They also have in the hindwings, extending from the anal angle to and sometimes beyond the tail a row of 4 or 5 black points capped with white which are more noticeable than in most



of the related species when present. Both sexes show the group tendency to white spotting along the mesial line on the underside of the hindwings.

Male genital armature:—while directly associated with *glycerium* the differences are evident, particularly in the gnathos. (Figs. 34, 35.)

Types:—holotype, male, and allotype, female, Caracas, Venezuela, from the collection of Mr. Frank Johnson and deposited in The American Museum of Natural History. Paratypes:—three males and two females, Caracas, Venezuela, all in the collection of Mr. Frank Johnson.

*Anaea johnsoni* Avinoff and Shoumatoff (Figs. 36, 37).

1884, *Anaea glycerium* Godman and Salvin, *Biologia Rhop.*, I, p. 337.

1888, *Anaea glycerium* Staudinger, *Exot. Tagf.*, I, p. 177.

1926, *Anaea glycerium* Kaye, *Trans. Ent. Soc.*, London, (1925), p. 474.

1941, *Anaea johnsoni* Avinoff and Shoumatoff, *Ann. Carnegie Mus.*, XXVIII, p. 313, Pl. XXXVI, Figs. 3-6.

Occurring apparently in restricted regions in the island of Jamaica, *johnsoni* appears to be a scarce species. References to it in literature are under the name "*glycerium*."

Godman and Salvin report Jamaica as a locality for *Anaea glycerium* based upon specimens in the British Museum. Staudinger takes a positive exception to this locality and calls attention to the extensive continental distribution of *glycerium*. Kaye gives the following records for "*glycerium*":—Blue Mountains, February 1920 at 2000 feet and Constant Springs, November 1923. Dr. A. Avinoff, in many trips to Jamaica, obtained a number of specimens at two localities in the Cockpit country.

The structure of the harpés and gnathos of *johnsoni* show conclusively that this species is closely associated with *glycerium* and *venezuelana* (Figs. 25-27, 34-37). It is genitally well separated from *cratias* which belongs in section 2.

A comparison of the facies of the imagoes of *johnsoni* and *venezuelana* show a great similarity between them in both sexes, in size, shape, upperside color and markings. On the underside they differ, for both sexes of *venezuelana* have a greenish, bronzy sheen and males of *johnsoni* have a prune-red tone like males of

Mexican *eurypyle confusa* to which they appear surprisingly similar. Females of *johnsoni* are buff and brown on the underside.

Comparing in the same way, either *johnsoni* or *venezuelana* with *glycerium* gives interesting results. Southern males of *glycerium* are larger and paler but in Mexico and Central America there occur small dry season males of *glycerium* which are very similar in appearance to both *johnsoni* and *venezuelana* males. This comparison does not hold for females.

The comparison of *johnsoni* with *cratias* in the original description is reasonable for they look much alike but with other and closer species for comparison and with genital study for confirmation, more exact placement is possible.

Considering the continental distribution of *glycerium*, its indicated subspeciation and production of seasonal forms, with a closely allied species (*venezuelana*), at the southern end of its range, it seems not unreasonable to suppose that *johnsoni* from Jamaica may have originated from some continental ancestral stock of the *glycerium* stem.

A summary of the facts as observed shows that the closely connected species, assembled in group II and then divided into three sections by their genital structures, contain three widely distributed species one of which occurs in each section.

*Anaea ryphea*, the single species with no close associates, in section 1, is most wide spread from Mexico to temperate South America.

*Anaea eurypyle* of section 2 ranges from equatorial Brazil westward, spreading from Bolivia to Colombia and, as the subspecies *confusa*, northward into Mexico. With *eurypyle* in section 2 are associated *sosippus* ranging from Bolivia to Ecuador, *ecuadoralis* confined to Ecuador, and *cratias* from western Brazil, Bolivia and southern Peru. The latter three species thus occur within the range of *eurypyle*.

*Anaea glycerium* of section 3 occurs in Mexico southward into Colombia and easterly probably through Venezuela as it is recorded from French Guiana. Associated with *glycerium* are *venezuelana* at the south of its range and *johnsoni* in Jamaica as an offshoot at the north.

The study of this group has been based on an examination of many hundreds of specimens from many localities and numerous genital preparations have been made from both sexes. The most useful information obtained concerns variation and the recognition of its nature. There is regional variation, seasonal variation and very marked individual variation; all of which, variously in each species, may affect the wing-shape and the color pattern. The distribution of the various species is also fairly well outlined.

### Group III

This might be named the *arginussa* group from the first species described by Hübner. It includes over a dozen *Anaea* names applied to continental species, subspecies and forms of undetermined validity, requiring revision. The species are from small to medium size, with sexes similar, both tailed at  $M_3$  of the hindwings. The forewings of the continental species have the outer margin broadly incurved from apex to tornus, some deeply so, and the inner margin incised near the tornus, some deeply so. The outer edges of both wings are more or less scalloped. The ground-color of continental species is black-brown with a larger or smaller, bright blue, basal area and a more or less extensive row of marginal or submarginal, blue (or white) spots. The underside has a generally similar pattern in all species but subject to great individual variation in definition.

The Antillean representatives of this group differ in having the outer margin of the forewings nearly straight, the inner margin broadly but slightly incurved within the tornus and the ground-color brown of various tones.

The male genitalia are distinctive with the gnathos extending ventrad and bridged by a narrow sclerite. The harpé has tubercles upon the upper surface of its outer lobe. The outline of the tegumen in dorsal view varies markedly between species.

The continental species are found in Mexico and Central America and throughout tropical South America. The Antillean species range spottily throughout the Greater and Lesser Antilles. All of these are closely affiliated with one continental species, *pithyusa*.

**Anaea pithyusa** (R. Felder) (Figs. 38-41).

- 1869, *Nymphalis pithyusa* R. Felder, Verh. zool.-bot. Ges., XIX, p. 473.
- 1884, *Anaea pithyusa* Godman and Salvin, Biologia Rhop., I, p. 345, Pl. 32, Figs. 7, 8.
- 1916, *Anaea pithyusa* Röber, Macrolep. World, V, p. 584, Pl. 118f.
- 1935, *Anaea pithyusa morena* Hall, Entom., London, LXVIII, p. 224.
- 1938, *Anaea pithyusa* Field, Ent. News, XLIX, p. 28.

Although widely distributed in South America, *pithyusa* was described from Potrero, near Cordova, Mexico and is found throughout Central America. There is an interesting northern record of it from Kenedy Co., Texas by Field.

The normal species is black-brown on the upperside with a slight, bright blue suffusion extending from the wing-bases. A row of submarginal blue spots extends across the forewings and a few white points occur near the tail. Normal females are duller than the males and brownish specimens occur which approach female form *morena* Hall with brownish-white spots on the forewings, a brownish basal dusting and a large dull fulvous discal area of the hindwing suggestive of *verticordia*. This form was described from Cayenne but it is generally distributed. A specimen from S. Pedro de Norte, Nicaragua, is typical.

The transition from blue-colored continental *pithyusa* to the various brown Antillean species is shown by the brown female form *morena*. The genital structures bear out the relationship (Figs. 38-45).

**Anaea echemus** (Westwood and Hewitson) (Figs. 42, 43).

- 1850, *Cymatogramma echemus* Westwood and Hewitson, Genera Diur. Lep., II, p. 316, Pl. 49, Fig. 4.
- 1857, *Megalura poeyi* Lefebvre, Sagra, Hist. Cuba, VII, p. 562.
- 1900, *Anaea echemus*, Sharpe, P. Z. S., London, p. 199.
- 1916, *Anaea echemus*, Röber, Macrolep. World, V, p. 583, Pl. 118d.
- 1935, *Anaea verticordia echemus* Bates, Butt. Cuba, p. 185.

The description consists of a figure of a female (British Museum, type No. 10364) reputedly from Honduras. Lefebvre described the male as *poeyi* from the neighborhood of Havana, Cuba. As the species is well distributed in Cuba, that island may be accepted as its proper home. It has also been taken at Nassau, Bahamas (Sharpe).

*Anaea echemus* is quite variable in size, upperside coloring and underside marking. The type female has a length of forewing of 31 mm. The basal half of the forewing is orange-brown and the apical half black-brown but paler along the outer margin. The hindwing is orange-brown except for a small apical patch of black-brown. On the underside a pattern like *pithyusa* may be traced but it is obscured by an overall design of fine brown and white striations. An anal patch extending beyond  $M_3$  in the hindwing is plain yellow-green with black spots between  $M_3$  and  $Cu_1$  and  $Cu_2$ . The red color of the type figure is too deep. In the series of specimens available for study the actual type specimen stands out as more strongly colored than most males and females which do not have so large or so bright an orange-brown area. Males are smaller than the females and average darker. The underside pattern of both sexes is highly variable, some show a strongly marked pattern like *pithyusa*, others have this completely lost in an overall effect of striations. The male genitalia show a close relation to *pithyusa*.

There is a difference in the forewing shape noticeable in our series of specimens which suggests that this species also develops seasonal forms.

***Anaea verticordia* Hübner (Figs. 44, 45).**

1823, *Papilio hypermnestra* Dalman, Anal. Entom., p. 42.

1827, *Anaea verticordia* Hübner, Zut. Samml. exot. Schmett., III, p. 35, Figs. 559, 560.

1871, *Papilio hypermnestra* Kirby, Syn. Cat. Diur. Lep., p. 637.

1884, *Anaea verticordia* Godman and Salvin, Biologia Rhop., I, p. 355.

1916, *Anaea verticordia* Röber, Macrolep. World, V, p. 583.

Dalman described *hypermnestra* without locality. Kirby leaves this name unlocated. Dalman's description is clear and well

defines *verticordia*, but *Papilio hypermnestra* is a homonym and cannot be used, so *verticordia* is valid.

Hübner described and figured *verticordia* giving the locality as "Havannah." His information would seem to be incorrect for there is no known record of this species from Cuba, whereas it is well known from Hispaniola and his figures fit the usual male occurring there. Therefore *verticordia* is used to denominate the Hispaniola population.

*Anaea verticordia* though of larger size and different color on the upperside, closely resembles *pithyusa*. The forewing marginal row of five spots appears similarly placed, and also the spots in the anal area of the hindwing. On the underside the variable pattern, as in *echemus*, follows *pithyusa*. The dimorphic female *morena* is the obvious connecting link.

The male genital structure of *verticordia* shows its close relationship to *echemus* and *pithyusa* and also its specific validity (Figs. 44, 45).

***Anaea verticordia dominicana* Godman and Salvin.**

1884, *Anaea dominicana* Godman and Salvin, P. Z. S., London, p. 316.

1916, *Anaea verticordia dominicana* Röber, Macrolep. World, V, p. 583, Pl. 118d.

This was described as a species from Dominica but was correctly placed as a subspecies by Röber. The figure given by Röber is misleading because the dark brown apical and marginal marking is much heavier than the type or in any specimen of our long series. The male genitalia of *dominicana* and *verticordia* are the same.

***Anaea verticordia luciana* Hall.**

1929, *Anaea verticordia luciana* Hall, Entom., London, LXII, p. 133.

The type localities are given as St. Lucia and Martinique and both the type and our specimens from Martinique show a more heavily marked butterfly than *dominicana*. The apical brown area of the forewing is more extensive, extending further towards the base. The five marginal spots are more evident than in

*dominicana* but not as large or as well defined as in *verticordia*. The male genitalia are the same as *verticordia*.

**Anaea pleione** (Godart).

1819, *Nymphalis pleione* Godart, Enc. Méthod., IX, p. 336.

Godart says of this:—"We suspect that it inhabits the Antilles." The description is sufficiently enlightening to make it certain that *pleione* belongs to the *verticordia* group but it does not fit exactly any of the butterflies available to us. Therefore *pleione* is placed tentatively as a species.

**Hypna clytemnestra** (Cramer).

1779, *Papilio clytemnestra* Cramer, Pap. Exot., II, pp. 61, 148, Pl. 137, A, B.

This species has been included in the genus *Anaea* through its subspecies *iphigenia* Lucas, which occurs in Cuba, by Bates (1935, Butt. Cuba, p. 183).

The forewing neuration suggests this but the structure of the male genital armature raises a doubt. This armature differs from that of any *Anaea* with which the authors are familiar and a varied selection has been examined. Without more extended study of the species of *Anaea* and species placed in other closely associated genera, *clytemnestra* cannot be accurately placed. It would seem best therefore for the present to leave it in the genus *Hypna*.

Summary

This study includes all the species of *Anaea* so far known from the Greater and Lesser Antilles. The relationships of the various butterflies to each other and also their relationships to continental butterflies are shown. The taxonomy of the island species is cleared of some misconceptions and a step taken toward clearing problems which exist with the numerous continental species of this large genus.

With more definite placing of the related insular and continental species there is a better understanding of their geographical distribution. This gives a broader application to the facts obtained and adds a small quota to the accumulated knowledge of

the origins of the fauna of the Antilles. All evidence points to an origin of the various island populations from the Central American mainland and not from South America through the Lesser Antilles. Only one species extends markedly into the Lesser Antilles and the evidence is that this has spread from the Greater Antilles and came originally from Central America. In all cases, whether a continental species is considered to be the actual ancestor or was itself derived from some primitive stock there, the corresponding island species or subspecies is closely related although occurring as a definitely modified population. The evidence as a whole is of zoögeographical interest. The maps for each group, prepared from the records of specimens determined or considered reliable by us, give the approximate distributions of the species.

For those interested in pursuing the subject of distribution further, the following references will be useful.

- ANTHONY, H. E. 1925. Mammals of Porto Rico, Living and Extinct, etc. Sci. Survey of P. R. and Virgin Isl., IX, Parts 1-2, N. Y. Acad. Sci.
- DALY, R. A. 1935. The Changing World of the Ice Age. New Haven: Yale Univ. Press.
- DARLINGTON, JR., P. J. 1938. The Origin of the Fauna of the Greater Antilles, etc. The Quarterly Review of Biology, XIII, No. 3, pp. 274-300.
- GLICK, P. A. 1939. The Distribution of Insects, Spiders, and Mites in the Air. U. S. Dept. Agri., Tech. Bull. No. 673.
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- MATTHEW, W. D. 1939. Climate and Evolution, 2nd ed., rev. and enl., arranged by E. H. Colbert. N. Y.: N. Y. Acad. Sci.
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Taxonomic list of the species, subspecies, forms and synonyms

## ANAEA

### Group I

**andria** Scudder, Mississippi basin.

*ops* (Druce).

form dry, **andriaesta** Johnson and Comstock.



**aidea aidea** (Guérin), North and Central America.

form wet, **morrisonii** (Edwards).

*appiciata* Röber.

*morrisoni* Holland.

**aidea cubana** (Druce), Cuba.

**aidea floralis** Johnson and Comstock, Southern Florida.

form dry, **floraesta** Johnson and Comstock.

**troglogyta troglogyta** (Fabricius), Hispaniola.

*troglogdita* (Fabricius).

**troglogyta portia** (Fabricius), Jamaica.

*astina* Hübner.

**troglogyta borinquenalis** Johnson and Comstock, Puerto Rico.

**troglogyta astina** (Fabricius), St. Thomas, St. Croix, Virgin Islands.

*astinax* (Cramer).

*astianax* (Cramer).

*agathon* (Dalman).

**troglogyta minor** Hall, St. Kitts.

## Group II

### Section 1

**ryphea** (Cramer), Mexico to Bolivia and Paraguay.

form dry **phidile** Hübner.

*erythema* (Bates).

ab. *albomaculata* Neustetter.

### Section 2

**sosippus** (Hopffer), Ecuador and Peru.

form wet, **rutilans** (Butler).

**ecuadoralis** Johnson and Comstock, Ecuador.

**euryppyle euryppyle** (C. & R. Felder), Colombia to Bolivia.

**euryppyle confusa** Hall, Mexico to Panama.

**cratias** (Hewitson), Bolivia, Peru and Brazil.

*ornata* Röber.

### Section 3

**glycerium** (Westwood and Hewitson), Mexico to Colombia.

*helie* (Clerek).

**venezuelana** Johnson and Comstock, Venezuela.

**johnsoni** Avinoff and Shoumatoff, Jamaica.

## Group III

*pithyusa* (R. Felder), Central and South America.

form ♀ *morena* Hall.

*echemus* (Westwood and Hewitson), Cuba.

*poeyi* (Lefebvre).

*verticordia verticordia* Hübner, Hispaniola.

*hypermnestra* (Dalman).

*verticordia dominicana* Godman and Salvin, Dominica.

*verticordia luciana* Hall, St. Lucia, Martinique.

*pleione* (Godart), Antilles?

The proposal of new seasonal form names, the use of existing form names and the relegation of certain names previously considered specific to the status of forms is done with full recognition of the questionable validity of this action. Strictly these names may be considered as synonyms as they merely denote a broodal difference in the same species.

In the drawings the often heavy distal and ventral spining of the harpés is omitted because the desire was to make as clear as possible the underlying structure. In each case the most distinctive portions of the genital structure are figured to show the differentiation of the species or subspecies. For instance, in the eight species figured from No. 20 to 37 the gnathos give the most definite characters of difference though not the only ones. In the three species figured from No. 38 to 45 the gnathos show very slight differences but on the other hand the dorsal views of the tegumen give excellent characters.

All drawings were made by Miss Alice Gray from dissections in alcohol.

## PLATE VIII

Figures 1-5. *Anaea andria andriaesta* Johnson & Comstock ♂, Mobile, Alabama, September 3, 1925.

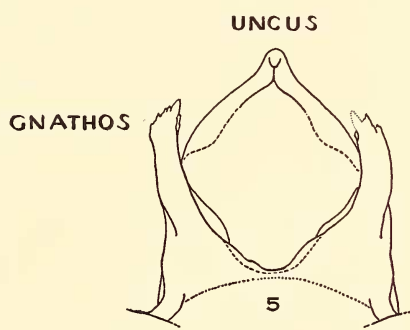
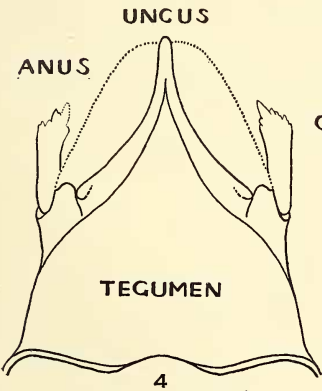
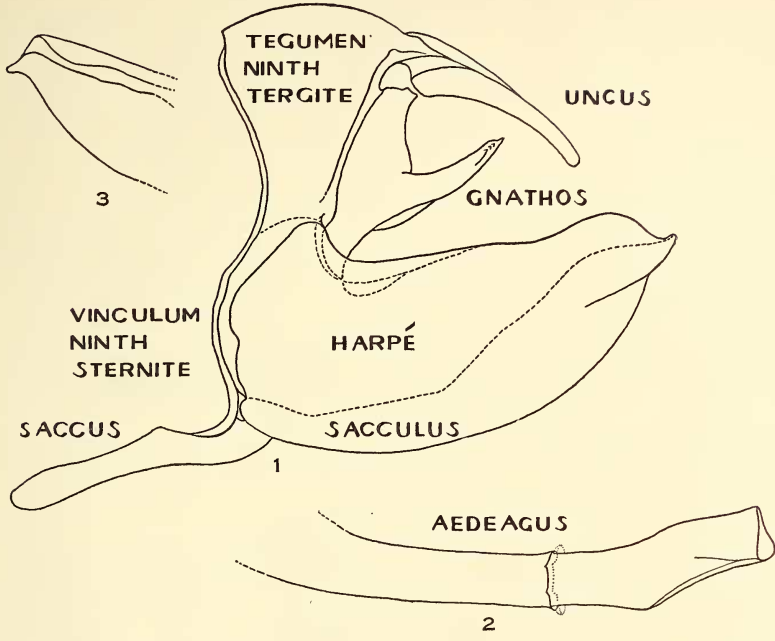
1—left lateral view of male genital armature.

2—ædeagus.

3—inside end of left harpé.

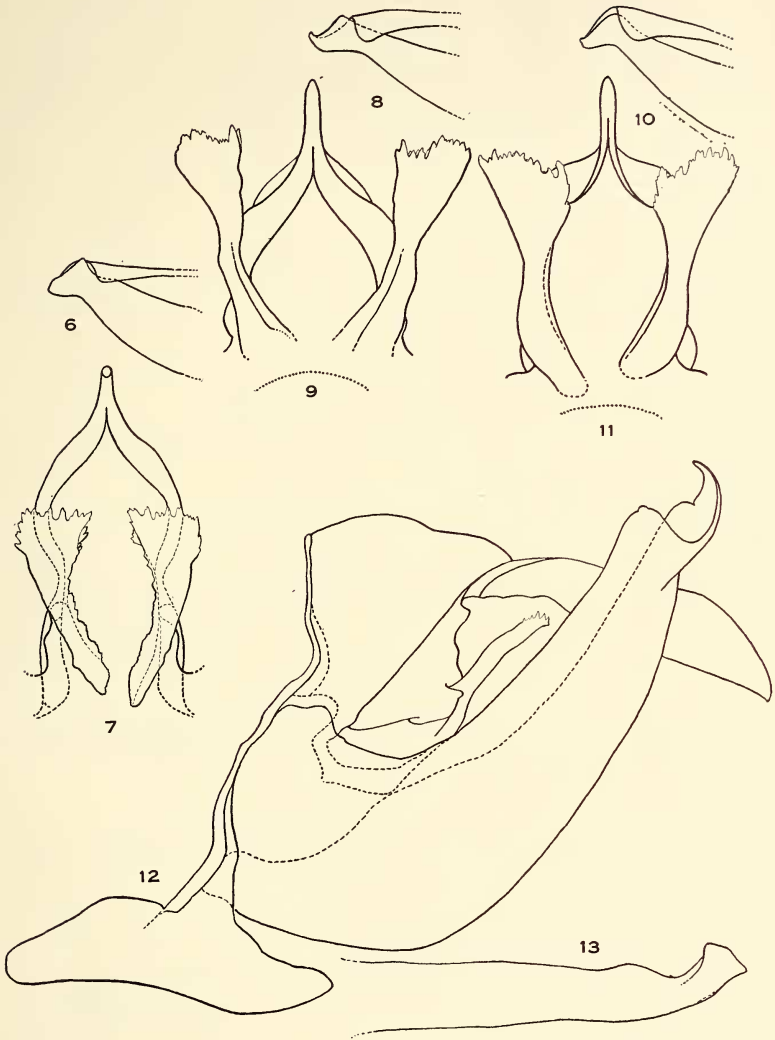
4—dorsal view of tegumen.

5—ventral view of gnathos.



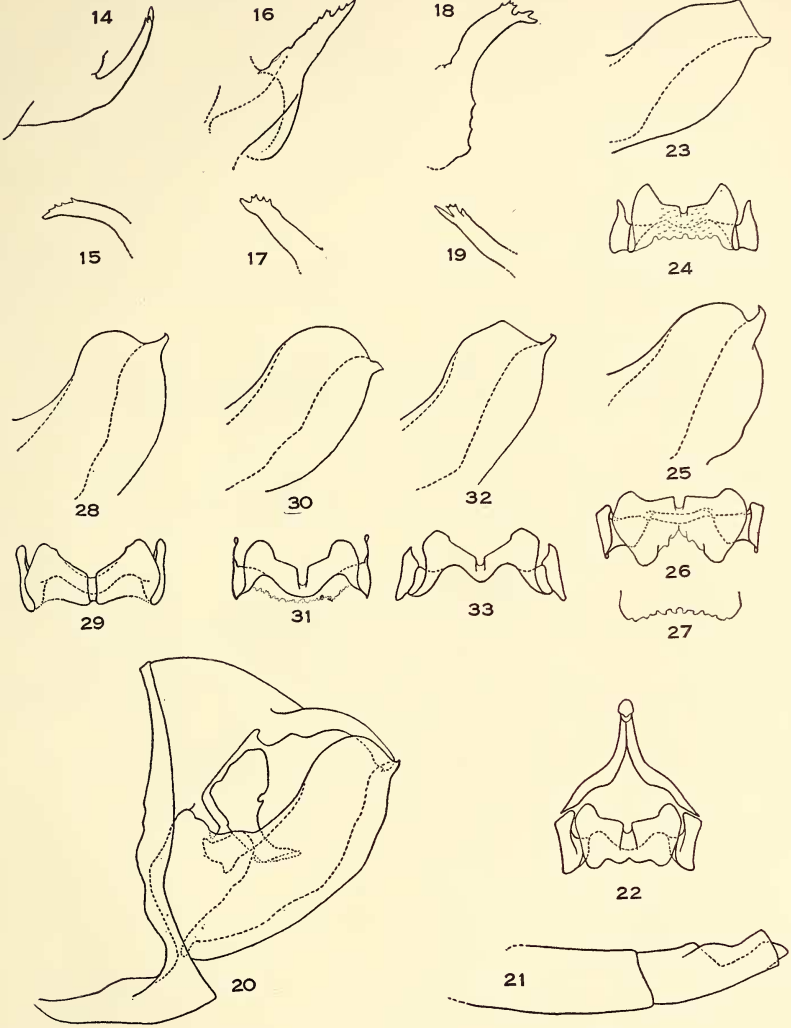
## PLATE IX

- Figures 6, 7. *Anaea aidea* (Guérin) ♂, Mexico. (In general the male genital armature is very similar to *andria*, Fig. 1.)  
6—inside end of left harpé.  
7—ventral view of gnathos.
- Figures 8, 9. *Anaea aidea cubana* (Druce) ♂, San Carlos Est., Guantánamo, Cuba, March 20, 1908.  
8—inside end of left harpé.  
9—ventral view of gnathos.
- Figures 10, 11. *Anaea aidea floridalis* Johnson & Comstock ♂, Biscayne Bay, Florida.  
10—inside end of left harpé.  
11—ventral view of gnathos.
- Figures 12, 13. *Anaea troglodyta* (Fabricius) ♂, Barahona, Republic Dominica, July 22-26, 1932.  
12—left lateral view of male genital armature.  
13—ædeagus.



## PLATE X

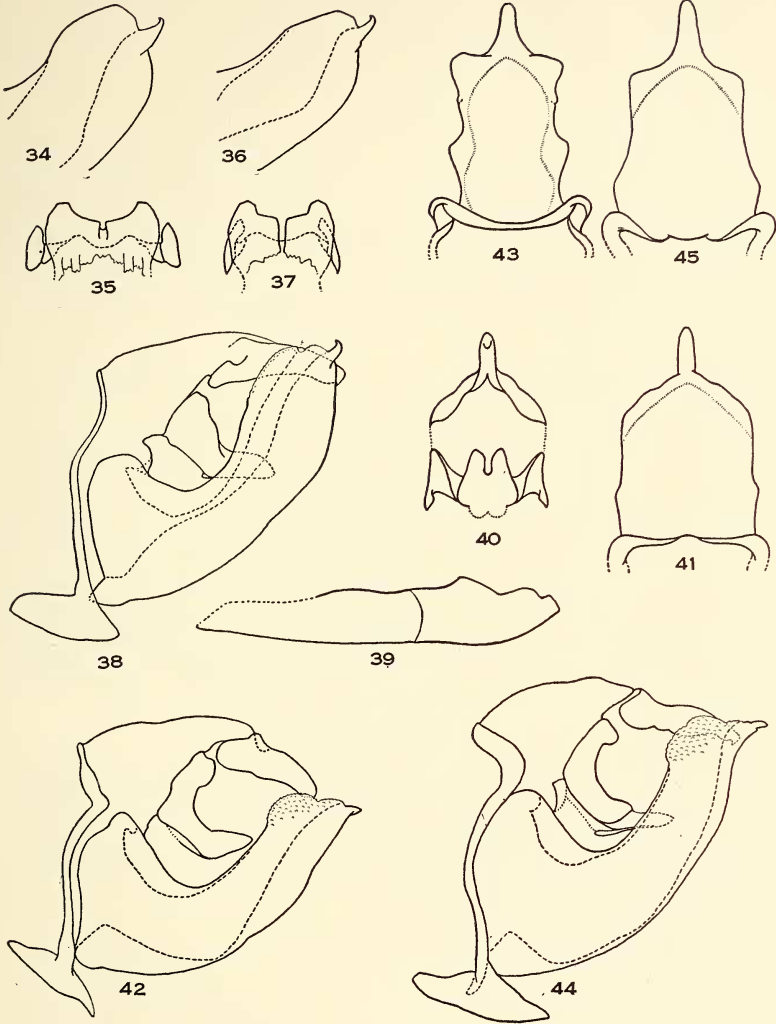
- Figures 14, 15. *Anaea troglodyta borinquenalis* Johnson & Comstock ♂, Guayanilla, Puerto Rico, July 22, 1914.  
 14—left gnathos, lateral view.  
 15—right gnathos, ventral view.
- Figures 16, 17. *Anaea troglodyta astina* (Fabricius) ♂, St. Croix, Virgin Islands, March 7, 1925.  
 16—left gnathos, lateral view.  
 17—right gnathos, lateral view.
- Figures 18, 19. *Anaea troglodyta portia* (Fabricius) ♂, Milk River, Clarendon, Jamaica, January 8–12, 1920.  
 18—left gnathos, latero-ventral view.  
 19—right gnathos, lateral view.
- Figures 20–22. *Anaea eurypyle confusa* Hall ♂, Mexico.  
 20—left lateral view of male genital armature.  
 21—ædeagus.  
 22—ventral view of gnathos.
- Figures 23, 24. *Anaea ryphea* (Cramer) ♂, Colombia.  
 23—outside, left harpé.  
 24—ventral detail, gnathos.
- Figures 25–27. *Anaea glycerium* (Westwood & Hewitson) ♂, Cordoba, Mexico.  
 25—outside, left harpé.  
 26—ventral detail, gnathos.  
 27—ventro-cephalic detail, gnathos.
- Figures 28, 29. *Anaea sosippus* (Hopffer) ♂, Rio Huallaga, Peru, December 12, 1925.  
 28—outside, left harpé.  
 29—ventral detail, gnathos.
- Figures 30, 31. *Anaea ecuadoralis* Johnson & Comstock ♂, Oriente, Ecuador.  
 30—outside, left harpé.  
 31—ventral detail, gnathos.
- Figures 32, 33. *Anaea cratias* (Hewitson) ♂, Bolivia.  
 32—outside, left harpé.  
 33—ventral detail, gnathos.



## PLATE XI

- Figures 34, 35. *Anaea venezuelana* Johnson & Comstock ♂, Caracas, Venezuela.  
34—outside, left harpé.  
35—ventral detail, gnathos.
- Figures 36, 37. *Anaea johnsoni* Avinoff & Shoumatoff ♂, Jamaica.  
36—outside, left harpé.  
37—ventral detail, gnathos.
- Figures 38–41. *Anaea pithyusa* (R. Felder) ♂, Mexico.  
38—left lateral view of male genital armature.  
39—ædeagus.  
40—ventral view of gnathos.  
41—dorsal view of tegumen.
- Figures 42, 43. *Anaea echemus* (Westwood & Hewitson) ♂, Cuba.  
42—left lateral view of male genital armature.  
43—dorsal view of tegumen.
- Figures 44, 45. *Anaea verticordia* Hübner ♂, Port-au-Prince, Haiti, February 19–28, 1922.  
44—left lateral view of male genital armature.  
45—dorsal view of tegumen.





## PLATE XII

## Map 1. Group I.

One species, *andria* (vertical lines), is endemic in the Mississippi basin. Another species, *aidea* (vertical dashes), slightly overlaps *andria* in the north and extends southward into Guatemala and Honduras. This species appears again in Cuba as *aidea cubana* and in southern Florida as *aidea floridalis*. The third species, *troglogyta* (diagonal lines), is endemic in the islands producing subspecies in Jamaica, Hispaniola, Puerto Rico, Virgin Islands and St. Kitts.

## Map 2. Group II.

Section 1; *Anaea ryphea* (vertical lines) is a dominant species of very extended range from Mexico to 25° south in South America.

Section 2; *Anaea euryppyle* (vertical dashes) is a dominant species extending from Mexico to Bolivia and Paraguay. Within its range *sosippus* (horizontal dashes) occurs in Colombia, Ecuador and Peru, *ecuadoralis* (right diagonals) in Ecuador, and *cratias* (left diagonals), overlaps its range in Peru and Bolivia and is detached in eastern Brazil.

Section 3; *Anaea glycerium* (vertical dots) is a dominant species extending its range from Mexico to the northern coast of South America. Within its southern range *venezuelana* (horizontal dots), occurs in central Venezuela and detached from its northern range *johnsoni* (horizontal dots), occurs in Jamaica.

## Map 3. Group III.

*Anaea pithyusa* (vertical lines) extends from Mexico into temperate South America with form *morena* occurring at least in its northern range. *Anaea echemus* (left diagonals), is found in Cuba and Nassau, Bahamas. *Anaea verticordia* (right diagonals), seems confined to Hispaniola but with subspecies *dominicana* in Dominica and *luciana* in St. Lucia and Martinique.

